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A FEED PREPARATION SYSTEM FOR CRUSTACEAN DIETS

by

George H. Balazs, Ernest Ross and Coy C. Brooks
Hawaii Institute of Marine Biology

INTRODUCTION

The development of experimental rations for crustaceans under consideration for aquaculture has been hampered by the lack of a simplified and inexpensive method of binding feed ingredients into a water-stable form. This is especially true if conventional feedstuffs are to be utilized. Standard pellets and "crumbles" manufactured for domestic animal production disintegrate rapidly when placed in fresh or sea water, thus fouling the medium and rendering nutrients less available for consumption. For juvenile and adult shrimps and crabs feed particles need to be bound tightly enough to prevent undue wastage during the slow mastication process thus ensuring that ingestion of a ration can continue for at least several hours after introduction. In addition, it is highly desirable to be able to store an animal ration without refrigeration.

Ingredients which have been tested for their binding ability include agar, alginates, carageenan, guar and locust bean gums, gelatins, celluloses and various other combinations of agents manufactured under brand names. Some success can be obtained with each of these additives when incorporated at the proper level into a diet. Experimentation in our laboratory has indicated that for any one of these binders, dissolution of feed is affected by feed ingredient combinations used, type of medium (sea or fresh water) and flow-rate and temperature of the medium. In addition, method of preparation is critical for some systems, thus close attention must be given to quality control if adequate binding is to be achieved. Although suitable for small batches, the large scale production of experimental rations bound with any of the above-mentioned additives is limited by 1) cost, 2) availability and 3) machinery which can be readily utilized in the manufacturing process.

FEED PREPARATION

Feed ingredients used in animal diets include soybean meal, fish meal, shrimp meal, brewer's yeast and ground corn, to name a few. Representative experimental crustacean diets of differing protein level and source are listed in Table 1. The ingredients were first weighed out according to formula and thoroughly blended in a dry feed mixer. All formulas contain 20% high gluten durum wheat (*Triticum durum*) flour. Hot water is added to the dry mixture at a rate of from 35% to 45% by weight. The exact quantity is dependent upon the particular combination of ingredients in the formula. Ration 1 used 45% and ration 4, 35%. The mass is thoroughly kneaded to wet all particles and to form a tough dough. Kneading is readily accomplished by passing the material three or more times through a heavy-duty meat chopper fitted with a large bore (10 mm) die. The machine used in this study is a Toledo Hi-Speed Chopper (Model 5521) fitted with a 5 hp motor and reduction gear drive.

The resultant dough is shaped into final form by extruding with the same machine through a small die. Rations in this study were prepared using a 3 mm die, although larger sizes may also be suitable. As the spaghetti-like strands were formed, they could easily be spread out on flat trays. When correct water additions are made, extruded material may be stacked as deep as 3 cm without sticking together. Extruded material is subsequently dried at 80°C for 10 hours in a forced air oven and sealed in air-tight heavy-duty plastic bags.

Table 1. Percent composition of prepared experimental crustacean diets.

Ingredient	DIET 1	2	3	4
Soybean meal	30.5	8.0	8.0	8.0
Hawaiian fish meal	–	4.0	6.5	11.5
Shrimp meal	–	15.0	24.0	42.0
Brewer's yeast	5.0	5.0	5.0	5.0
Corn, ground	40.5	47.0	35.5	12.5
Wheat flour, high gluten	20.0	20.0	20.0	20.0
Tricalcium phosphate	3.0	–	–	–
Vitamin-trace mineral premix	1.0	1.0	1.0	1.0
Total protein, calculated	25.0	25.0	30.0	40.0

RESULTS

Results of water stability tests conducted on diets prepared by this method are presented in Table 2. These data show that binding efficiency is affected by diet composition as would be expected. Stability in sea water was consistently better than in fresh water. Nutrient dissolution from each particle is apparently slower in sea water due to the higher ion concentration in comparison to fresh water. At the end of the five-hour tests all particles were still firm, retained original shape and could be handled without falling apart. Losses displayed in Table 2 were considered acceptable for aquatic crustacean feeding. Under intensive farming conditions it may be advantageous to feed growing shrimps every 3 to 4 hours, making a longer ration stability time unnecessary. In fact, the present cost of producing a more stable ration may well be uneconomical in terms of the benefits derived.

Rations were subsequently tested in feeding experiments to evaluate their growth promoting ability. Animals were held under controlled laboratory conditions in fibreglass aquaria which provided a 0.9 m^2 bottom area with no substrate. Results of these studies are presented in Table 3. In general these data show that all diets produced good growth with low mortality.

Under the conditions of this study it seems logical to conclude that the feed preparation method described offers a simple, rapid and relatively inexpensive technique for producing experimental crustacean rations with acceptable levels of water stability. In addition, these rations are capable of producing good growth when fed to two species of Penaeid shrimp.

Table 2. Percent dry matter weight loss of prepared crustacean diets in water(1)

Ration	1 hour		3 hours		5 hours	
	Sea	Fresh	Sea	Fresh	Sea	Fresh
1	6.7	10.7	9.8	11.6	11.3	12.4
2	6.4	11.9	8.2	11.9	8.4	12.3
3	5.9	13.1	9.5	13.2	11.4	13.4
4	5.8	14.3	9.1	16.3	10.5	16.6

(1) 26°C flowing at 6 litres per minute.

Table 3. Results of feeding studies using prepared crustacean diets.

Species	Ration	Number of animals	Experimental period (days)	Mean weight, grams Initial	Mean weight, grams Final	Weight Incr. (%)	Survival (%)
Penaeus japonicus	1	15	25	2.25	4.63	105.8	93.3
" "	2	15	25	2.27	4.70	107.0	86.7
" "	3	15	25	1.66	5.62	238.6	93.3
" "	4	15	25	1.50	6.44	329.3	100.0
Penaeus aztecus	2	155	25	0.58	1.20	107.0	95.5

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